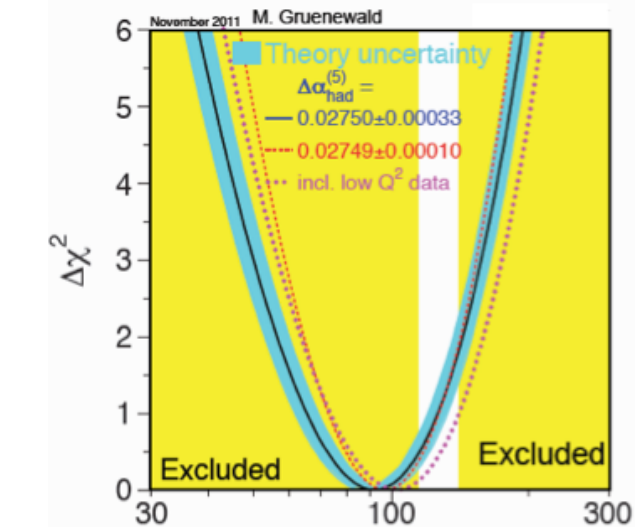


STAR Experiment

Nu Xu

- Introduction: *Structure of the QCD Matter*
- Near future physics programs

QCD in Twenty-One Century



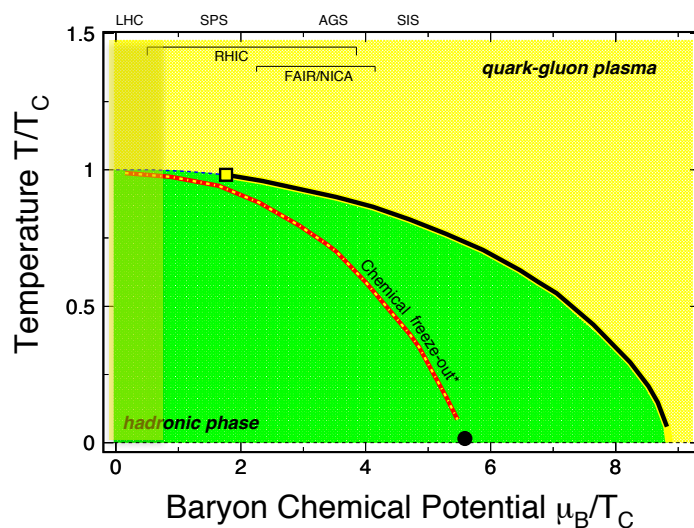
(1) Higgs Particle –

- Origin of Mass
- SM → The *Theory*

(2) QCD Phase Structure –

- Critical point, phase boundaries
- Confinement
- χ_c symmetry
- Nucleon helicity structure
- ...
- Non-linear QCD at small-x
- ...
- ...

Emerging Properties with QCD



A group of people, likely members of the STAR Collaboration, standing in front of a large industrial structure, possibly part of the RHIC accelerator.

STAR Collaboration

STAR Experiment at RHIC

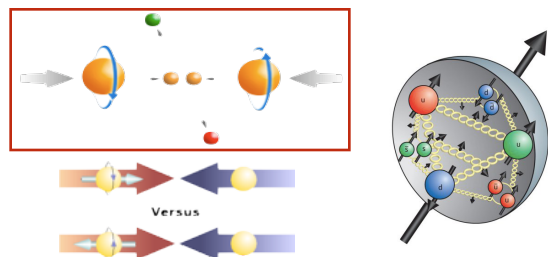
(<http://www.star.bnl.gov/>)

Fundamental science: particle physics, nuclear physics, astrophysics, cosmology, ...

State of art technology: detector R&D, computing, mass/fast data managing, ...

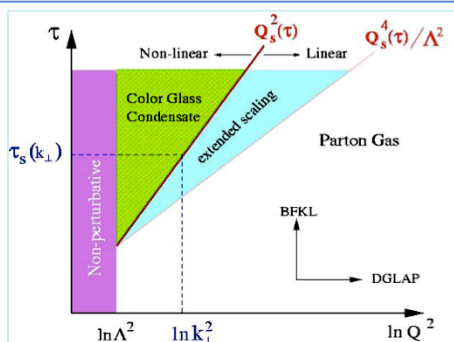
- 550 scientists
 - 54 institutes
 - 12 countries
 - ~ 140 PhD thesis completed since 2001
- 
- A close-up view of the STAR detector components, showing blue and yellow structural elements and a yellow safety barrier.

STAR Physics Focus



Polarized $p+p$ program

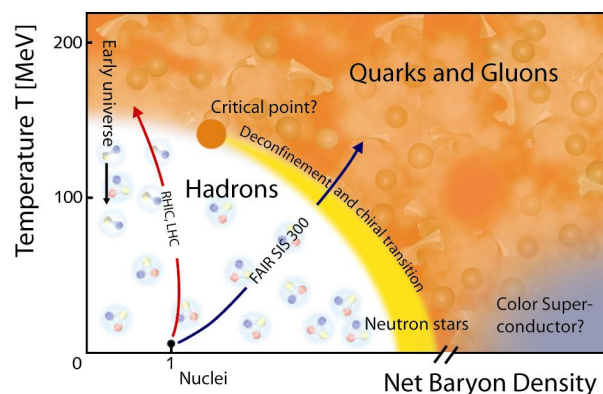
- Study **proton intrinsic properties**



Cold Nuclear Matter

- Study low-x properties, initial condition, search for **CGC**
- Study parton distribution function of nucleon/nuclei

2020 -
eRHIC
(eSTAR)



1) At 200 GeV at RHIC

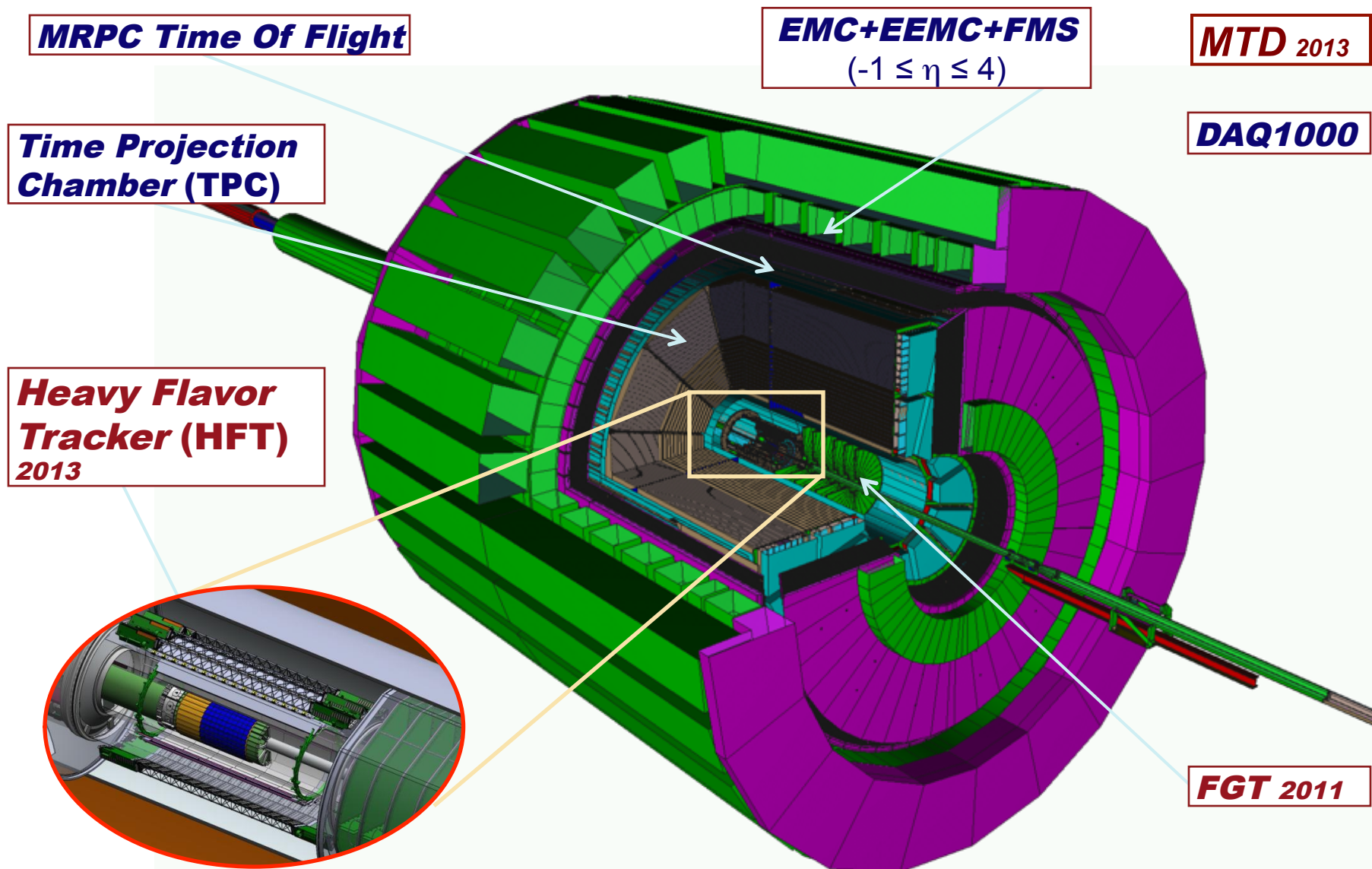
- Study **medium properties, EoS**
- pQCD in hot and dense medium

2) RHIC beam energy scan (BES)

- Search for the **QCD critical point**
- Chiral symmetry restoration

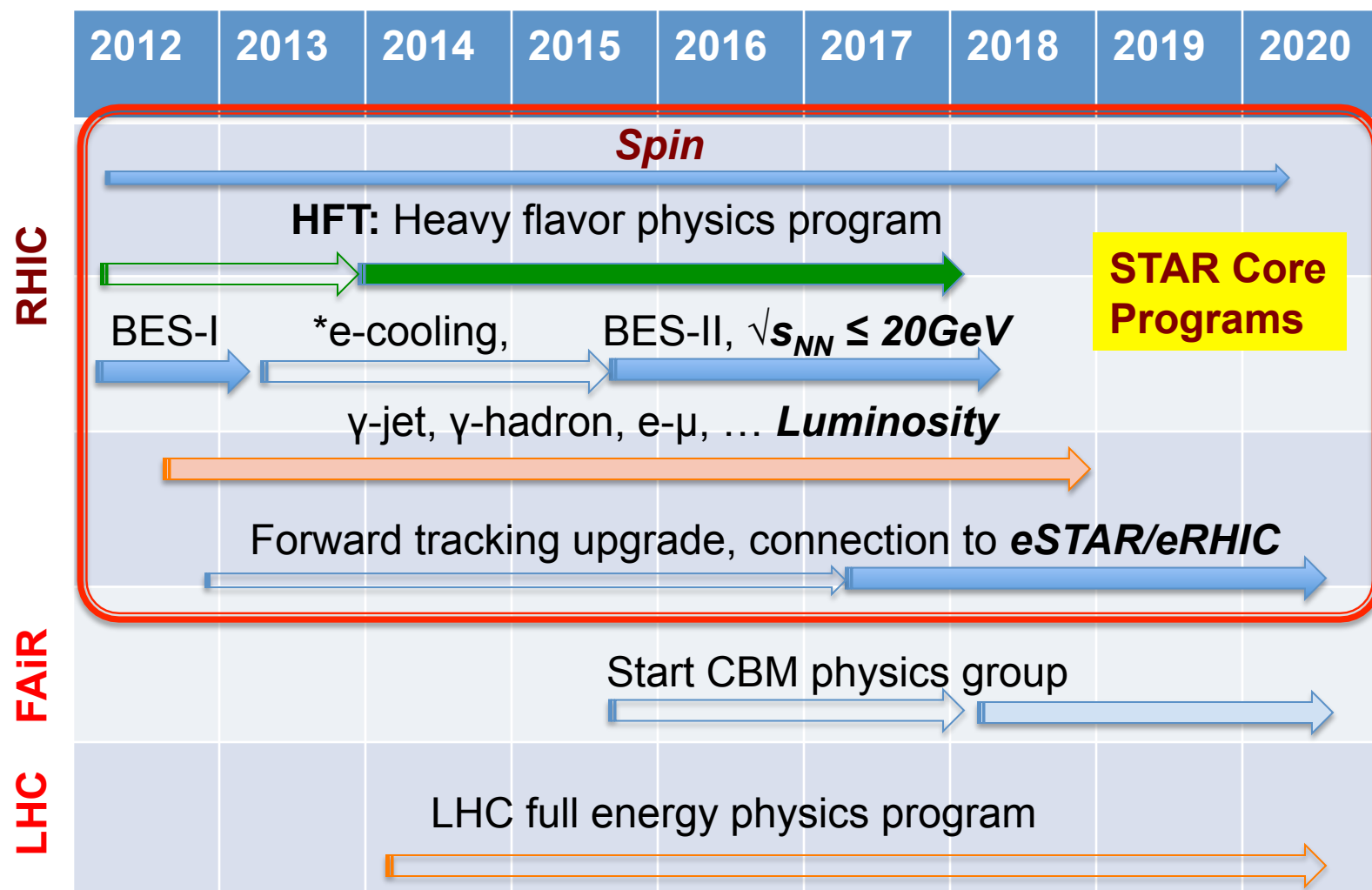


STAR Detectors *Fast and Full azimuthal particle identification*





Study QCD Phase Structure



Summary

- 1) RHIC: Dedicated facility for studying matter with QCD degrees of freedom:
 - *Properties of QGP*
 - *Sea quark and gluon contributions to proton helicity structure*
 - *QCD critical point, phase boundary*

- 2) Future: EIC (eRHIC, 2022 - ...)
 - *Partonic structures of nucleon and nuclei*
 - *Dynamical evolution from cold nuclear matter to hot QGP*

Phase Structures of QCD Matter